Space Weather Technical Forecast

Issued on Sunday, 21 August 2022 at 01:13 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1 peaking 22 into 23 August. R1 risk falling. Chance of Active electron fluence into new week.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has fallen to Very Low over the past 24 hours, with only B-class activity recorded at GOES16, as background X-ray flux fell markedly when compared to the end of the past UTC working week. This trend was strongly tied to the fortunes of the recent most active spot, AR3078, which showed a marked fading trend over the past 36 hours as it has neared the southwestern limb. This group finished the period as a Dri/Beta, having been a Dkc/BGD for a time on Friday 19 August.

This spot group was one of up to five on the disc at present, with the others mostly simple magnetic dipoles or monopoles. The sole other region of interest, at least on paper, was AR3081, a Cao/Beta group in the northwest, although this spot proved unremarkable in terms of flares in the period.

The arriving eastern solar hemisphere appears much blander than the departing west in terms of the starkness of opposing magnetic polarities in HMIBC imagery. The combination of this quieter face becoming increasingly dominant and the fading of activity from across the disc has led to a notable quietening in the past 24 hours, with the Penticton 10.7cm flux correspondingly falling from 131sfu on Monday 15 August to 102 on Saturday 20 August

No Earth-directed CMEs were observed in available coronagraph imagery.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR and ACE at L1, was symptomatic of both a waning fast wind regime from CH14/-, and also a minor CME arrival at L1 at 20/1725UTC. This followed yet another CME arrival before the start of this reporting period at 19/1702UTC, which had eased by the time the later event took effect.

The solar wind speed initially fell from early Strong levels at 650km/s to a nadir near 475, before undergoing a rise with the passing of the CME from 1725UTC. This saw a resurgence to the upper-500s of km/s for a time, with this too moderating as the 24-hour period drew to a close. The associated solar wind density showed a relatively flat trend, mainly in single figures ppcc but peaking at around 10ppcc with the 1735UTC CME's onset. The interplanetary magnetic field strength (IMF), Bt showed a volatile tendency, with a peak near 9nT, while the north-south component Bz varied between +/-7nT. The phi angle was mostly negative (towards the Sun) but with a distinct and smooth rotation visible from 20/0300UTC, perhaps related to the earlier 19/1702UTC CME's magnetic cloud.

The net result of the above solar wind measures on provisional geomagnetic activity was an early and late peak of Active Kp 4- in the 00-03UTC and 21-24UTC intervals, else being mainly Quiet.

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Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES16, was at Background levels.

The high energy electron flux (greater than 2 MeV) spent much of the first half of the UTC day at Normal Background levels as the first CME buffeted the Van Allen belts, but this gradually recovered somewhat as geomagnetic activity eased, eventually rising to a peak of High and 1740pfu at 20/1940UTC, before declining into the UTC evening.

The 24-hour integrated electron fluence was below the Active threshold on a near-level trend, with an observed value of 5.93e7 integrated pfu at 21/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low to Very Low, with AR3078 both weakening, and in any case departing the disc into the new week, with little to compensate on the current facing side or else arriving over the eastern solar horizon.

Solar Wind / Geomagnetic Activity: The geomagnetic forecast is low confidence throughout, largely the result of the sheer number of mostly minor CMEs from AR3078, with some cases of glancing incidence possible, now perhaps most likely on 22 August, with two others having recently arrived (19/1702UTC and 20/1735UTC). Otherwise, the CH14 fast wind is expected to continue to gradually ease over the current weekend, ahead of a second coronal hole fast wind from CH16 perhaps incident on Tuesday 23 August.

Geomagnetic activity is expected to be Quiet to Unsettled for much of the period, but with further spells of Active to G1 Minor Storms due to any CME glances, now thought most likely straddling the UTC days of 22 and 23 August.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) will most likely remain at Background levels.

High energy electron flux should show an upward tendency in the period, the result of reaction to the fast wind from coronal hole 14, albeit tempered by any CME arrivals, which lower the confidence in the forecast. This may give Active 24 hour fluence, most likely during the first half of the four-day forecast period, prior to geomagnetic activity from a possible CME and coronal hole arriving in succession from later on 22 and through 23 August.

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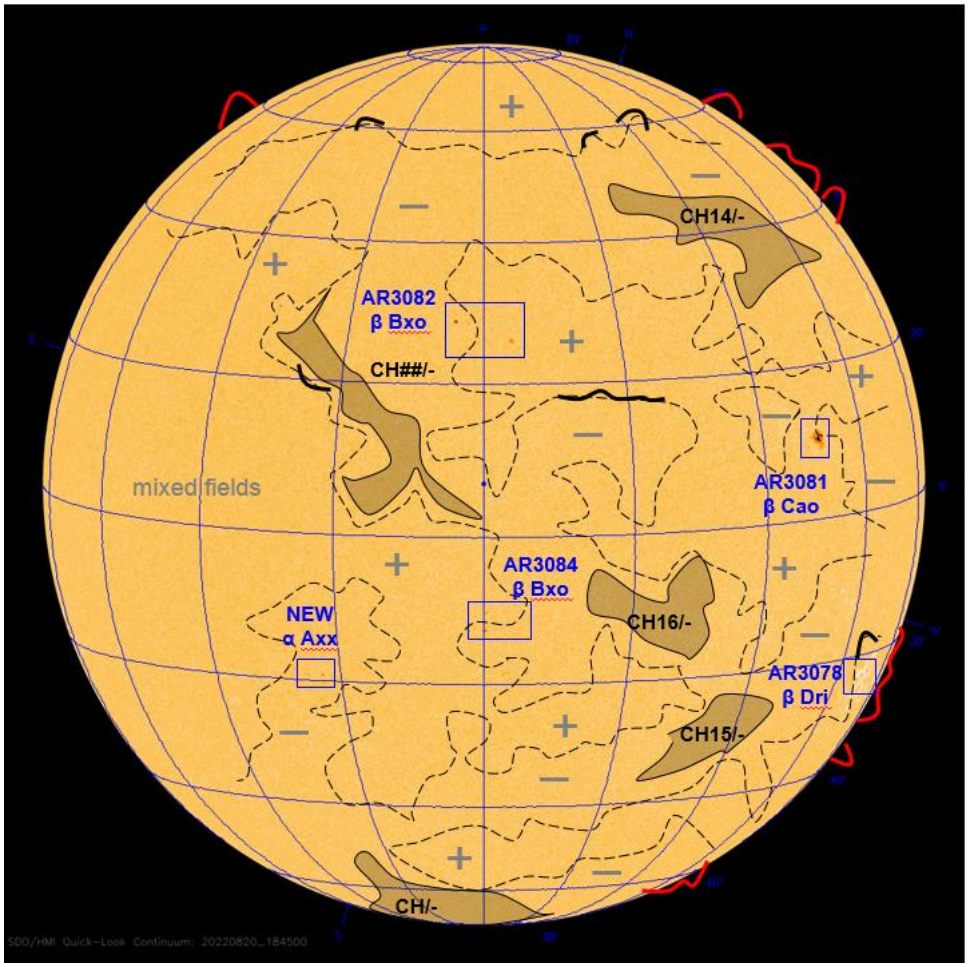
Figure 1. Solar Analysis Valid 20/1845UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

The geomagnetic forecast is low confidence throughout, due to the number of mostly minor CMEs from AR3078, with amalgamation of these likely and some cases of glancing incidence still possible. The main period of risk is now considered later on day two, Monday 22 August into day three (Tuesday 23), although minor glances prior to this cannot be ruled out.

The current coronal hole fast wind from CH14 is now thought to be in decline along with the minor CME arriving 20/1735UTC. A quieter period of geomagnetic activity should now ensue to round out the current UTC weekend. Consideration then shifts to the above forecast CME arrival 22 into 23 August, and from there another coronal hole, CH16. This coronal hole is not a persistent feature on the disc, with most likely arrival on day three (Tuesday 23 August). This forecast is supported by MOSWOC Enlil, which has been verifying well recently, providing moderate confidence in the coronal hole aspect of the forecast.

Geomagnetic activity is expected to be Quiet to Unsettled for much of the period, but with further spells of Active to G1 Minor Storms due to any CME glances, most likely later day two (Monday 22 August) into day three, perhaps bolstered by CH16 later on 23 August.

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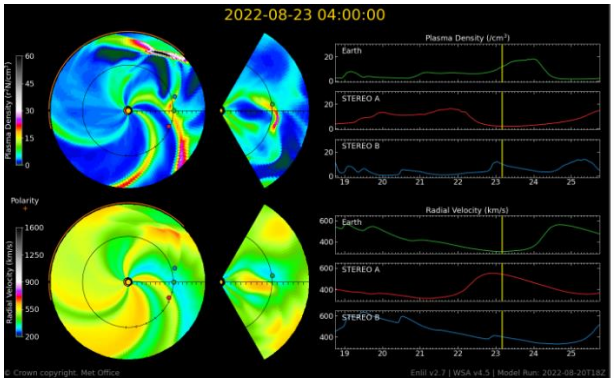
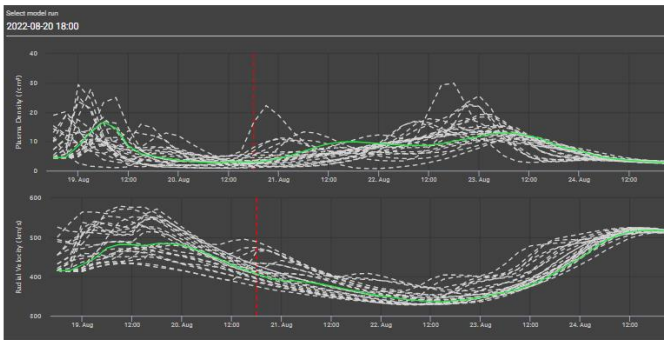
Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	30	30	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
19/0922	Partial	AR3078	40W25S	700km/s	22/1800UTC +/-12h	Probably now preceding CH16 to lesser effect. Volatile arrival time in models perhaps result of complex CME interactions

Figure 2: Latest available MOSWOC Enlil and ensemble, showing a near-continuous series of potential minor CME arrivals in the first half of the coming week, capped by CH16.





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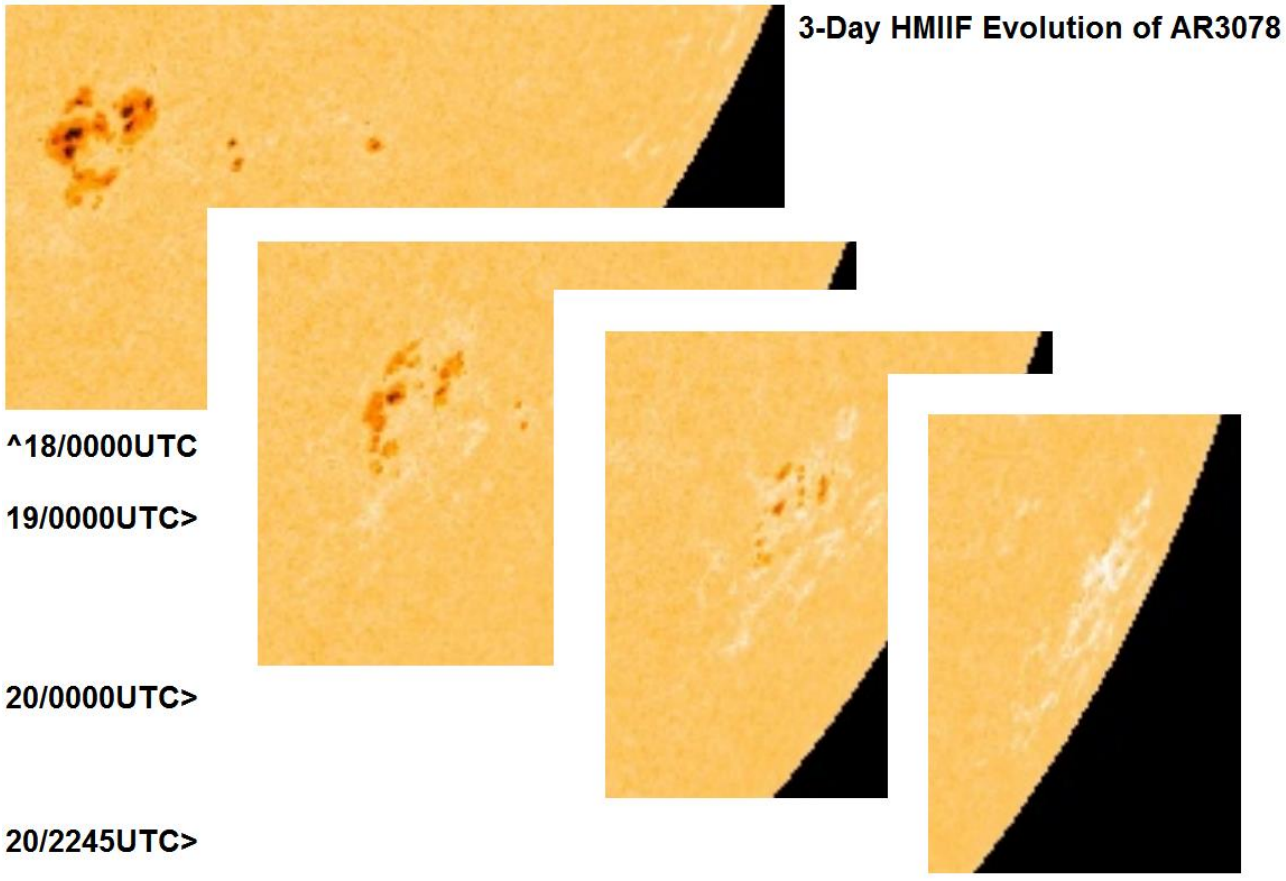
Radio Blackouts - X-Ray Flares:

Solar activity has been strongly tied to AR3078 in recent days, and now this spot group is both fading and nearing the western solar horizon, the prospects for further Moderate activity are in decline, with little to succeed it on either the remainder of the front side or over the eastern solar horizon.

The chances of M-class activity are therefore Slight throughout, with a falling tendency into the new working week UTC.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3:



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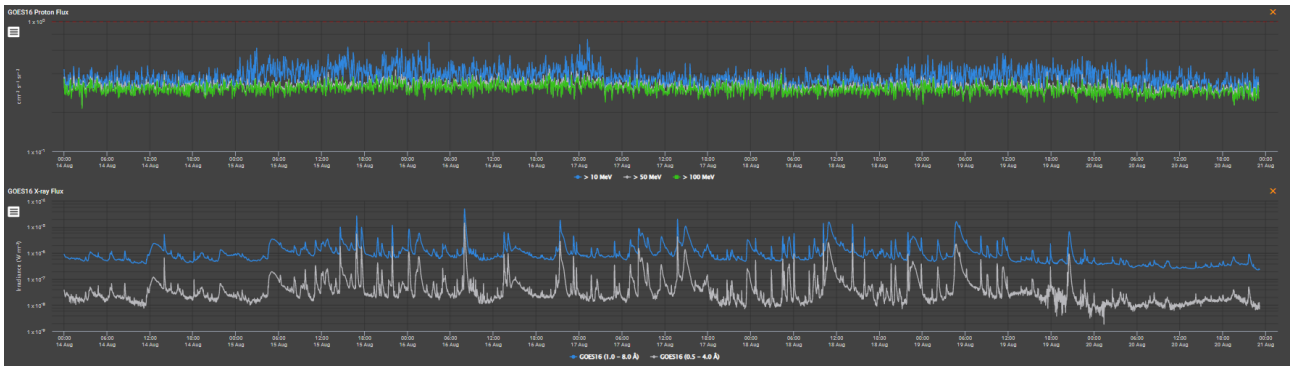
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 is at background, with recent days' very slight enhancements (all comfortably sub-S1) having eased.

There remains a very slight chance of further enhancement due to the location of weakening AR3078 in the southwest, but although this group has produced solar radiation events, they have been very minor (comfortably sub-S1).

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Past week in GOES16 high energy proton flux (top), showing minor (sub-S1) enhancements in response to frequent C and M-class activity, with this largely from AR3078.



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High Energy Electrons Event (≥ 2MeV):

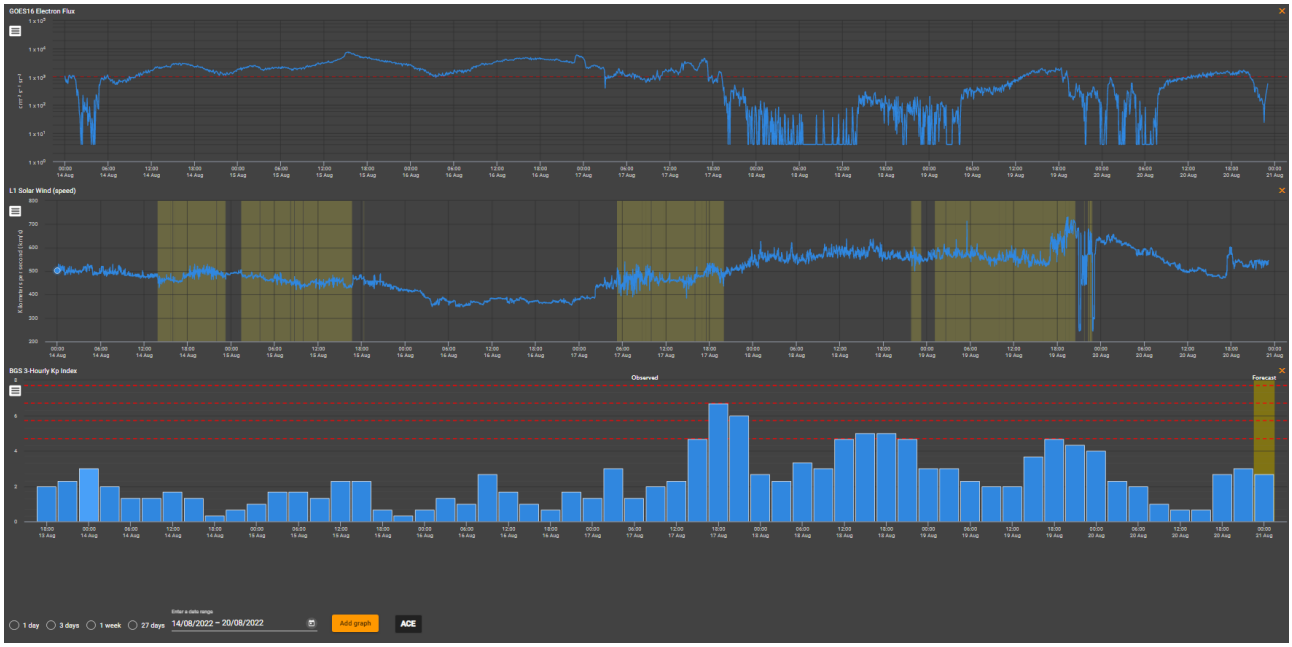
The high energy (greater than 2 MeV) electron flux as observed at GOES-16 has shown a response to both the current fast wind from CH14, but also the successive CMEs, with effects combining to make the electron forecast both volatile and of relatively low confidence.

In the absence of any CMEs, flux levels were expected to rise to be mostly High as the CH14 fast wind eased, however this has been delayed and perhaps dented by a pair of recent CME arrivals. A degree of recovery in values is likely over the remainder of the UTC weekend, although this may now be lower than previous thoughts. A more likely and more lasting reduction in flux may now occur with the arrival of a CME on 22 into 23 August, with another coronal hole fast wind from CH16 on the 23rd. This second coronal hole is not a persistent feature, and appears visually smaller than CH14, with solar wind speeds and the reaction from electron flux probably of lower magnitude as a result.

Overall, the volatile nature of the flux forecast means that the associated 24-hour fluence is low confidence, but should reach its peak for the period before the end of the UTC weekend, with levels then rallying for a time, ahead of more decided declines later in the four days.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	60	60	30	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: Past week in GOES16 high energy electron flux (top), showing reaction to fast wind at L1 (middle, DSCOVR and ACE (yellow shading)), but frequently being attenuated by geomagnetic activity (BGS 3-hourly Kp indices, bottom).



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